

P-10.1 Summarize the first and second laws of thermodynamics.

Revised Taxonomy Level 2.4 Summarize conceptual knowledge

In physical science students

- ❖ “Explain the process of phase change in terms of temperature, heat transfer, and particle arrangement.”(PS-3.7)
- ❖ “Explain how the law of conservation of energy (including mechanical energy, electrical energy, chemical energy, light energy, sound energy, and thermal energy).” (PS-6.1)

It is essential for students to

- ❖ Understand that the internal energy of a substance is the total of all of the energies inside of a substance including
 - Kinetic energy of jostling molecules
 - Rotational kinetic energy of molecules
 - Kinetic energy due to internal movements of atoms within the molecules
 - Potential energy due to the forces between molecules
- ❖ Understand that the first law of thermodynamics
 - Can be generally stated as: “Whenever heat is added to a system, it transforms into an equal amount of energy that may include other forms.”
 - You cannot get any more energy out of a system than you put in.
 - This is a restatement of the law of energy conservation applied to heat.
 - The heat that is added to a system can do one or both of two things:
 - If it remains in the system it will increase the internal energy of the system (by increasing any combination of the forms listed above)
 - If it leaves the system it will do external work on another system
- ❖ Understand that the second law of thermodynamics
 - Can be generally stated as: “When energy transforms, some of it degenerates into waste. The wasted energy is unavailable and is lost.”
 - You cannot get as much energy out as you put in.

Assessment

The revised taxonomy verb summarize means “to abstract a general theme or major point” For this indicator, the major focus of assessment should be to insure that students have a deep conceptual understanding of the terms system, internal energy, heat, and work. Conceptual knowledge requires that students understand the interrelationships among the basic elements within a larger structure that enable them to function together. In this case, that students understand the how the Law of conservation of energy is applied to thermal systems, in terms of work and internal energy.